Terrestrial Ecological Assessment

For
Concept Plan Approval for
Proposed Marina
& Mixed Use Development

Trinity Point, NSW

Prepared for
Johnson Property Group
PO Box A1308
Sydney South NSW 1235

HARPER SOMERS O'SULLIVAN
PLANNING · SURVEYING · ECOLOGY
A member of RPS Group Plc

Job Reference 20970 - November 2008

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PROJECT: TERRESTRIAL ECOLOGICAL ASSESSMENT – CONCEPT PLAN FOR TRINITY POINT MARINA AND MIXED USE DEVELOPMENT	
CLIENT:	*JOHNSON PROPERTY GROUP PTY LTD*
OUR REFERENCE:	*20970*
DATE:	*NOVEMBER 2008*
APPROVED BY:	*MAYA BERETTA*
SIGNATURE:	
CHECKED BY:	*DEBORAH LANDENBERGER*
SIGNATURE:	

EXECUTIVE SUMMARY

INTRODUCTION

RPS Harper Somers O'Sullivan (RPS HSO) has been commissioned by Johnson Property Group to undertake a Terrestrial Ecological Assessment for the Concept Plan for Trinity Point Marina and Mixed Use Development at Trinity Point, Morisset Park, Lake Macquarie, in NSW. The proposal is to be assessed under Part 3A of the *Environmental Planning and Assessment Act 1979*. The development project is referred to as 'Trinity Point Marina'.

The study area is located on the foreshore of the Morisset Park peninsula, surrounded by Lake Macquarie and includes lands previously occupied by the St. John of God training centre. The subject site assessed within this Terrestrial Ecological Assessment report (referred to as 'the subject site') is a smaller area that extends to the high water mark of Lake Macquarie and west to the edge of the proposed development.

The scope of this report is to assess the terrestrial flora and fauna within the study area a separate Aquatic report has been prepared by Ecology Lab (2008) to assess the aquatic flora and fauna.

The Proposal

The proposal is seeking Concept Plan approval for Trinity Point Marina and Mixed Use Development. Broadly, the resultant development to arise out of the proposed guidelines is for a staged 308 berth marina plus associated marina facilities/uses including boat maintenance facilities), daytime helipad, marina/tourist village, tourist accommodation and residential accommodation, with associated landscaping, parking, stormwater and other utilities/services, plus public access.

Methodology and Results

The development of the Terrestrial Ecological Assessment for Trinity Point Marina comprises the following aspects:

- **Collation and review of existing flora and fauna datasets and survey reports** – Six previous flora and fauna investigation and assessment reports undertaken by HSO (2007; 2004; 2003a; 2003b; 2002; and 2001) were reviewed as part of this ecological assessment. Additionally the NPWS Atlas of NSW Wildlife and BioNet databases were searched for threatened species records within 10 km of the subject site. An EPBC Act Protected Matters Search within 10 km of the subject site was consulted.

- **Vegetation survey & mapping datasets** – The vegetation assessment included a review of the Lower Hunter Central Coast Regional Environmental Management Strategy (LHCCREMS) regional vegetation mapping (House, 2003). A subject site inspection was undertaken to map the vegetation communities to a finer scale than previously undertaken by HSO (2001).

- **Threatened species surveys and habitat investigations** – Further threatened species habitat assessment has been undertaken as part of this ecological assessment report using information presented in HSO (2001; 2003b; 2004) and collected during the subject site inspection.

- **Subject site inspections** - Two RPS HSO Ecologists undertook a site inspection on 30 September 2008 to mapping vegetation and to assess the current condition and

habitat values of the trees within the subject site. Another site inspection to record bat calls on the nights of the 8 and 9 October 2008.

FLORA

The flora survey methodology consisted of a combination of quadrats, transects, random meanders and targeted searches for threatened flora species considered likely to occur within the subject site.

A total of 144 flora species were identified during the survey period within the subject site and study area within the quadrats and random meander surveys. Eight vegetation communities were found within the study area. The majority of the subject site was cleared comprising an exotic open pasture while the remaining vegetation communities mapped were remnant or planted vegetation. The eight vegetation communities included:-

- *Avicennia marina* Open Forest
- *Casuarina glauca* Open Forest – EEC (Swamp Oak Floodplain Forest)
- *Eucalyptus tereticornis*/*Angophora floribunda* Open Forest – EEC (River-flat Eucalypt Forest on Coastal Floodplains)
- *Juncus kraussii* Saltmarsh – EEC (Coastal Saltmarsh)
- *Sarcocornia quinqueflora* Saltmarsh - EEC (Coastal Saltmarsh)
- *Sporobolus virginicus*/ *Sarcocornia quinqueflora* Saltmarsh – EEC (Coastal Saltmarsh)
- Planted non-indigenous trees and shrubs
- Open Pasture.

No threatened flora species were recorded during investigations or were considered likely to occur within the subject site. Two EECs were found within the subject site including highly degraded River Flat Eucalypt Forest consisting only of scattered remnant Rough-barked Apple (*Angophora floribunda*) and Forest Red Gum (*Eucalyptus tereticornis*), and Swamp Oak (*Casuarina glauca*) Floodplain Forest on the lake edge. An additional EEC of Coastal Saltmarsh was delineated within the study area.

FAUNA

Methods employed targeting fauna species included:

- fauna habitat assessment;
- significant tree survey;
- terrestrial mammal trapping;
- arboreal mammal trapping;
- bat call detection (Anabat II detector);
- avifauna survey (diurnal and nocturnal surveys);
- herpetofauna surveys;
- spotlighting;
- secondary indications and incidental observations.

- stagwatching of hollows;
- call playback of the Masked Owl (*Tyto novaehollandiae*), Powerful Owl (*Ninox strenua*) and Barking Owl (*N. connivens*); and
- hollow-bearing tree survey.

Results

Fauna habitat within the subject site was found to be limited to remnant trees and riparian vegetation. Winter flowering tree species recorded within the subject site include Forest Red Gum (*Eucalyptus tereticornis*), which may provide foraging resources for nectarivorous bird and mammal species. Additionally, figs (*Ficus* sp.) located within the southern portion of the subject site are likely to provide some foraging habitat for frugivorous species such as the Grey-headed Flying Fox (*Pteropus poliocephalus*).

No hollow-bearing trees were recorded within the subject site or the study area. During the recent site inspection, three mature Forest Red Gums (*E. tereticornis*) that would represent foraging habitat for a number of fauna species were recorded within the central portion of the proposal footprint.

Fauna species recorded within the subject site were limited to common species able to persist in open, disturbed habitats.

Two threatened fauna species were recorded within the study area during surveys, the Eastern Freetail Bat (*Mormopterus norfolkensis*) and the Large-footed Myotis (*Myotis adversus*). Six other threatened fauna species were considered likely to occur within the study area:

- Osprey (*Pandion haliaetus*);
- Grey-headed Flying Fox (*Pteropus poliocephalus*);
- Eastern Bentwing Bat (*Miniopterus schreibersii*);
- Little Bentwing Bat (*Miniopterus australis*); and
- Greater Broad-nosed Bat (*Scoteanax ruepelli*).

ECOLOGICAL IMPLICATIONS OF THE PROPOSAL

The proposed development footprint is designed to minimise vegetation removal, however a small area of Swamp Oak Floodplain Forest will require removal for the proposed boat lift. These trees comprise a highly disturbed example of the Swamp Oak Floodplain Forest (SOFF) endangered ecological community (EEC). The modifications are predominantly associated with clearing for the Boat lift in Area A. Three remnant *Eucalyptus tereticornis* (Forest Redgums) will be required for removal within the Open Pasture vegetation community. These trees are isolated from the remaining native vegetation within the subject site.

The removal or modification of foraging habitat (vegetation) for threatened fauna species recorded or considered likely to occur within the subject site is considered a minor impact considering the proportion of habitat available in the local area, the highly mobile nature of the species and the small amount of foraging habitat to be removed within the subject site.

ENVIRONMENTAL LEGISLATION ASSESSMENT

Section 3A of the EP&A Act 1979 Key Thresholds Assessment

The Key Thresholds Assessment concluded that the potential impacts arising from the proposed Trinity Point Marina on threatened species recorded or considered likely to occur within the subject site are of a small scale and magnitude. The proposal is considered unlikely to adversely impact on threatened species recorded or considered likely to occur within the subject site.

SEPP 44 'Koala Habitat Protection'

Harper Somers O'Sullivan (2001) found that the subject site and adjacent areas represented 'Potential Koala Habitat' as defined by SEPP 44. Within the subject site, Forest Red Gum (*Eucalyptus tereticornis*) is the only Schedule 2 Koala feed tree.

Direct searches of Koala within the subject site included spotlighting and diurnal searches. Indirect searches for evidence of Koala included searches for scats and scratches on tree trunks, particularly targeting primary browse species. No evidence of Koala was found within the study area and adjoining lands and no individuals were observed (HSO, 2001; 2003b).

The most recent local Koala records are from 1997 near Morisset and from 1996 at Mannering Park (Atlas of NSW Wildlife data). Historical records that exist within 10 km of the study area include:

- 1950's on Pulbah Island in Lake Macquarie
- 1986 from Wangi Point

A lack of recent Koala records from the local area indicate that any local Koala population, should one exist, it is likely to be at very low density.

Whilst the subject site offers potential Koala habitat, the lack of recent records combined with no evidence of Koala within the subject site indicates that a resident population is unlikely to occur. As a result the subject site was not considered to constitute core Koala habitat under SEPP 44 and no further provisions of SEPP 44 apply to the subject site.

EPBC Act 1999

A total of 23 nationally listed threatened species under the *EPBC Act 1999* have been recorded within the proximate region of the study area. It is considered unlikely the current proposal will have a significant impact upon local populations of Commonwealth listed threatened and migratory species such that local extinctions would occur. As such, it is unlikely to be a controlled action and thus referral to the Department of Environment, Water, Heritage and the Arts (DEWHA) is not necessary.

RECOMMENDATIONS

The potential impacts arising from the proposed Trinity Point Marina on threatened species, populations and/or endangered ecological communities listed under TSC Act and/or EPBC Act, are considered to be minimal. However, a number of mitigation measures could be implemented to further reduce potential impacts. Recommended mitigation measures are:

- Minimise potential impacts associated with erosion and sedimentation on adjacent sensitive communities (ie Saltmarsh and riparian vegetation) and Lake Macquarie

during construction through the inclusion of appropriate erosion and sediment controls.

- Adopt recommendations made by The Ecology Lab to minimise impacts on the aquatic environment and associated communities (ie mangroves and saltmarsh).

- Minimise potential impacts arising from stormwater runoff into adjacent riparian areas (Coastal Saltmarsh, River-flat Eucalypt Forest and Swamp Oak Floodplain Forest EECs) and Lake Macquarie by designing and installing appropriate stormwater detention and/or filtering devices.

- Prepare a vegetation management plan under the Statement of Commitments for the retained areas of vegetation along the foreshore within the study area for continued monitoring and weed control. This plan will compliment the Vegetation Management Plan which has previously been prepared for the estuarine vegetation communities within the study area (RPS HSO 2008).

- Under the aforementioned VMP undertake Assisted Rehabilitation and Re-instatement of SOFF and extant vegetation as discussed within section 4.5.1.

GLOSSARY OF TERMS

DBH – Diameter at Breast Height

DCP – Development Control Plan

DECC – NSW Department of Environment and Climate Change (formerly NSW National Parks and Wildlife Service, NSW Department of Environment and Conservation)

DEWHA - Commonwealth Department of Environment, Water, Heritage and Arts

DGEARs - Director-General's Environmental Assessment Requirements

EEC - Endangered Ecological Community

EP&A Act – NSW *Environmental Planning & Assessment Act 1979*

EPBC Act – Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*

GPS – Global Positioning System

ha – hectare

HBOC – Hunter Bird Observers Club

LEP – Local Environmental Plan

LGA – Local Government Area

LHCCREMS - Lower Hunter and Central Coast Regional Environmental Management Strategy

LHRCP – Draft Lower Hunter Regional Conservation Plan

LHRS – Lower Hunter Regional Strategy

ROTAP – Rare or Threatened Australian Plants listed by Briggs and Leigh (1996)

RPS HSO – RPS Harper Somers O'Sullivan

SF – State Forest

Subject Site – the site subject to this Terrestrial Ecological Assessment Report

ssp. / subsp. – sub-species

Study Area – the subject site including terrestrial vegetation surrounding Bardens Bay

TSC Act – NSW *Threatened Species Conservation Act 1995*

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APPENDICES

1 INTRODUCTION

RPS Harper Somers O'Sullivan (RPS HSO) has been commissioned by Johnson Property Group to undertake a Terrestrial Ecological Assessment for the development of land at Trinity Point, Morisset Park, Lake Macquarie, in NSW. The proposal is to be assessed under Part 3A of the *Environmental Planning and Assessment Act 1979* (EP&A Act). The development project is referred to as 'Trinity Point Marina'.

This report is a revised Terrestrial Ecological Assessment to deal specifically with the suite of potential impacts on terrestrial ecology as a result of the proposal to develop the land to incorporate a marina and mixed use resort. It has been prepared under the guidance of the Director General Environmental Assessment Requirements (DGEAR's) with due reference to the *Draft Guidelines for Threatened Species Assessment (DEC/DPI, 2005)* as relates to Part 3A applications and in accordance with section 75H (2) and Clause 8D of the *Environmental Planning and Assessment Regulation 2000*.

The 'study area' is located on the foreshore of the Morisset Park peninsula, surrounded by Lake Macquarie (Figure 1-1). The study area includes lands previously occupied by the St. John of God Training Centre. The 'subject site' addressed within this Terrestrial Ecological Assessment report is a smaller area that extends to the high water mark of Lake Macquarie and west to the edge of the proposed development (Figure 1-2).

This report considers the requirements of the DGEARs as set down for this project (Refer to Appendix A). It includes the likelihood of the proposal to have a significant effect on any threatened species, populations or Endangered Ecological Communities (EECs) listed within the *Threatened Species Conservation Act 1995* (TSC Act 1995). The report recognises the relevant requirements of the EP&A Act 1979 as amended by the EP&AA Act 1997. Consideration of potential constraints has also been undertaken in relation to the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act 1999) to assess whether there are any matters of National Environmental Significance (NES) existing on site that may require further assessment.

Specific information pertaining to the ecology of the subject site has been documented previously by HSO (2001; 2003b; 2007). These reports combined with a recent site inspection to verify and update findings have been used as the ecological dataset upon which assessments have been based within this report. These reports have been appended to this assessment report (Refer to Appendices C, D and E).

1.1 Site Particulars

Locality – Morisset Park peninsula on the shore of Lake Macquarie, NSW.

LGA – Lake Macquarie.

Title(s) – Lot 31 DP 1117408, part Lot 33 DP 1117408 and part Lot 32 DP 1117408 (Figure 1-4)

Area – Approximately 3.94 ha

Current Zoning –6(2) Tourism and Recreation, 6(1) Open Space and 2(1) Residential.

Boundaries – The subject site is generally bound to the north, south and east by 6(1) Open Space zoned land that edges the Lake, with the exception of several easement areas that extend to the high tide mark of Lake Macquarie. To the west is an unnamed shallow bay, and residential zoned land that is approved for and being progressively development for residential subdivision.

Current Land Use – The subject site is vacant land pending development. Formerly the subject site was used as the St. John of God Training Centre and contained training centre buildings, associated facilities, open space, pasture and vacant lands. The training centre buildings and facilities have since been demolished.

Topography - Generally the subject site is gently sloping towards the water on all sides from the central to southern plateau, which continues to rise offsite to the west. Southern portions of the subject site contain a steep drop-off to the water via a sandstone cliff face up to approximately 8m in height.

Vegetation – The subject site consists mainly of cleared pasture with small areas of remnant native vegetation, including a fringe along the riparian area and some planted vegetation surrounding a former building site.

1.2 Description of the Proposal

The proposal is seeking Concept Plan approval for Trinity Point Marina and Mixed Use Development. The concept plan provides a broad overview of what is proposed and sets up the framework for future applications and approvals via a set of urban design guidelines. The urban design guidelines include controls relating to land use, building setbacks, building heights, public access, open space, built form, FSR and site coverage, building materials, landscaping, roads for vehicular access and parking, stormwater and soils, flooding, services and waste management, marina and helipad, acoustics, sustainable development, indigenous and European heritage and staging.

Broadly, the resultant development to arise out of the proposed guidelines is for a staged 308 berth marina plus associated marina facilities/uses including boat maintenance facilities), daytime helipad, marina/tourist village, tourist accommodation and residential accommodation, with associated landscaping, parking, stormwater and other utilities/services, plus public access. See Figure 1-3 for concept plan.

Of direct relevance to this Terrestrial Ecological Assessment, given the location of vegetation, are the marina guidelines which outline a boat lift facility which includes two steel runway beams crossing a vegetated area, two elevated crossings from the land based marina to the water based marina components.

1.3 Scope of the Study

This study was designed to incorporate the results of detailed ecological inventories undertaken across the subject site and study area. This report aimed to:

- update the ecological report;
- map the vegetation communities within the study area in detail;

- assess the conservation status of the vegetation communities present;
- undertake further bat surveys;
- identify necessary offsets in accordance with DECC's requirements; and
- Provide a concise tree plan and accompanying data for impact assessment purposes.

This Terrestrial Ecological Assessment Report incorporates the above scope to enable informed assessments to be made regarding potential ecological impacts as a result of the proposal, and if necessary, provide appropriate recommendations to reduce any significant impacts on threatened flora and fauna and / or EECs.

This study has been structured on the guidelines laid down in the EP&A Act 1979, which requires consideration of the impact of the proposed development upon any protected fauna but particularly on 'threatened' species (collective term for Schedule 1 – Endangered, and Schedule 2 – Vulnerable species as listed in the TSC Act 1995), Endangered Populations or EECs expected or occurring within the subject site. Consideration of potential constraints has also been undertaken in relation to the Commonwealth EPBC Act 1999.

Figure 1-1 shows the location of the study area in a regional context, Figure 1-2 shows the location and an aerial photograph of the study area and subject site in local context, whilst Figure 1-3 shows the proposal. Figure 1-4 show the Lot and DP numbers and the locations of the Easements which are referred to throughout this report.

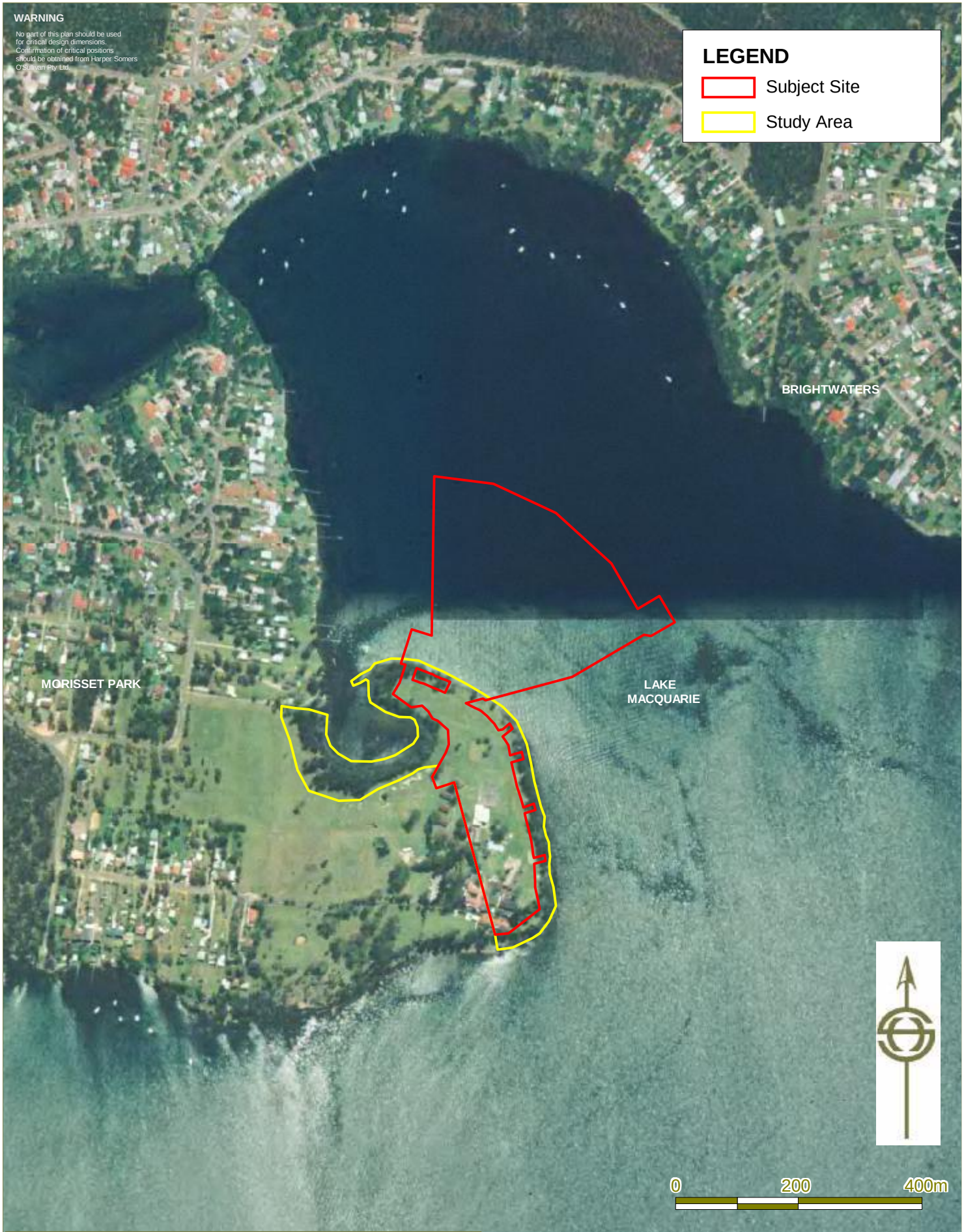
The scope of this report is to assess the terrestrial flora and fauna within the study area a separate Aquatic report has been prepared by Ecology Lab (2008) to assess the aquatic flora and fauna.

1.3.1 Director General Requirements

This Terrestrial Ecological Assessment is intended to investigate the potential ecological impacts of the concept plan as required by the Part 3A DGEAR's. The key issues which relate to the Flora and Fauna, where and how they are addressed are outlined in Table 1-1.

Table 1-1: DGEAR's and Assessment Details

DGEAR Criteria	Dealt with in Section	Assessment
Assess Potential impacts on threatened species, populations and endangered ecological communities in accordance with the draft *Guidelines for Threatened Species Assessment DEC & DPI July 2005*	Appendix E, Section 4, Section 5	Assessment of affect threatened species and communities in Appendix E. Discussion on vegetation removal in Section 4. Assessment of impacts under Key Thresholds Assessment and discussions on maintain and improve in section 5.
Address measures for the conservation of flora and fauna and their habitats	Section 5, Section 6.2 *Recommendations*	Rehabilitation of native vegetation along Lake Foreshore and production of vegetation management plan.
Address impacts on migratory species, RAMSAR wetlands and species listed under section 18 and 18A of the EPBC Act.	Section 5.3	Assessment under EPBC Act as to whether the proposal will have or is likely to have a significant impact upon matters of National Environmental Significance, or on the environment of Commonwealth Land.
Address the impacts on flora and fauna in accordance with the *Lake Macquarie Flora and Fauna Survey Guidelines*	Section 3.1.2, 3.1.3, Section 5.1, Section 4.3.2. Refer to Table 2-1	Adhere to flora and fauna survey guidelines and identify regionally significant flora, fauna and vegetation communities
Address the *NSW Groundwater Dependant Ecosystem Policy*	Section 3.2	Identification of GDE's within subject site and assess impact of concept plan under the NSW Groundwater Dependent Ecosystem Policy.



TITLE:
Figure 1-1 Locality Map

CLIENT: Johnson Property Group Pty Ltd

PLANNING SURVEYING ECOLOGY

HARPER SOMERS O'SULLIVAN

SCALE: 1: 8000 at A4 Size DRAWN: A.Saddington APPROVED: D.Landenberger

DATUM: MGA Zone 56 (GDA 94) DATE: 20/10/2008

LAYOUT REF:

CONTOUR INTERVAL: N/A

JOB REF: 20970

241 DENISON STREET BROADMEADOW PO BOX 428 HAMILTON NSW 2303
T: 02 4961 6500 F: 02 4961 6794 E: survey@hso.com.au W:www.hso.com.au ABN 11 093 343 858

TITLE:
Figure 1-2 Study Area & Subject Area

CLIENT:
Johnson Property Group

SCALE: 1: 3758.93 at A4 Size DRAWN: A.Saddington APPROVED: D.Landenberger

DATUM: MGA Zone 56 (GDA 94) DATE: 21/10/2008

LAYOUT REF:J:\JOBS\20k\20970 - Trinity Point\Marina & Resort - 2007-2008\MapInfo\WORKSPACES\REPORT WORKSPACES\20970 Figure 1-2 Study area & Subject site

CONTOUR INTERVAL: N/A

JOB REF: 20970

PLANNING SURVEYING ECOLOGY

HARPER SOMERS O'SULLIVAN

241 DENISON STREET BROADMEADOW PO BOX 428 HAMILTON NSW 2303
T: 02 4961 6500 F: 02 4961 6794 E: survey@hso.com.au W:www.hso.com.au ABN 11 093 343 858

Figure 1-3: Indicative Proposed Layout

TITLE:
Figure 1-4 Lot Numbers and Easements

CLIENT:
Johnson Property Group

PLANNING SURVEYING ECOLOGY

HARPER SOMERS O'SULLIVAN

SCALE: 1: 3758.93 at A4 Size DRAWN: A.Saddington APPROVED: D.Landenberger

DATUM: MGA Zone 56 (GDA 94) DATE: 21/10/2008

LAYOUT REF:J:\JOBS\20k\20970 - Trinity Point\Marina & Resort - 2007-2008\Mapinfo\WORKSPACES\REPORT WORKSPACES\20970 Figure 1-4 lot numbers and easement

CONTOUR INTERVAL: N/A

JOB REF: 20970

241 DENISON STREET BROADMEADOW PO BOX 428 HAMILTON NSW 2303
T: 02 4961 6500 F: 02 4961 6794 E: survey@hso.com.au W:www.hso.com.au ABN 11 093 343 858

1.4 Definitions

The definitions given below are relevant to the Director General's requirements:

'development' has the same meaning as in the NSW Environmental Planning and Assessment Act 1979.

'subject site" is the site within which development is proposed.

'study area' refers to the subject site inclusive of development lands and conservation areas adjoining Bardens Bay.

All other definitions are the same as those contained in the NSW *TSC Act*.

1.5 Qualifications and licensing

1.5.1 Qualifications

The following ecologists from RPS HSO undertook the Ecological Assessment Report:

- Anna McConville (B Env Sc);
- Deborah Landenberger (B Sc, Hons)
- Maya Beretta (B Env Sc)
- Craig Anderson (B App Sc (EAM);
- Toby Lambert (B Env Sc); and
- Matt Doherty (B.LMC).

1.5.2 Licensing

Research was conducted under the following licences:

- NSW National Parks and Wildlife Service Scientific Investigation Licence S10300 (Valid 30 November 2008);
- Animal Research Authority (Trim File No: 01/1142) issued by NSW Agriculture (Valid 12 March 2009);
- Animal Care and Ethics Committee Certificate of Approval (Trim File No: 01/1142) issued by NSW Agriculture (Valid 12 March 2010); and
- Certificate of Accreditation of a Corporation as an Animal Research Establishment (Trim File No: 01/1522 & Ref No: AW2001/014) issued by NSW Agriculture (Valid 22 May 2011).

1.6 Sub-consultants, Personal Communications and Observations

1.6.1 Sub-consultants

RPS HSO used the following organisations during this study where appropriate input was required.

Microchiropteran Bat Analysis: Anna Lloyd
40 Fishermans Drive
EMERALD BEACH NSW 2456
P: 0427 029732
E: robania@tpg.com.au

1.6.2 Personal Observations

Relevant observations made by the authors or other RPS HSO ecologists outside of the project or other published studies have been included within this report as 'personal observations' (pers. obs.).

1.7 Certification

As the principal author, I, Deborah Landenberger make the following certification:

- The results presented in the report are, in the opinion of the principal author and certifier, a true and accurate account of the species recorded, or considered likely to occur within the study area and subject site;

- All research workers have complied with relevant laws and codes relating to the conduct of flora and fauna research, including the *Animal Research Act 1995, National Parks and Wildlife Act 1974* and the *Australian Code of Practice for the Care and Use of Animals for Scientific Purposes*.

Signature of Principal Author and Certifier:

Deborah Landenberger
Botanist/Ecologist
RPS Harper Somers O'Sullivan
November 2008

2 METHODOLOGY

2.1 Summary of methods

The research and preparation of the Ecological Assessment for Trinity Point Marina comprised of the following aspects.

2.1.1 Collation and review of existing flora and fauna datasets and survey reports

Six previous flora and fauna investigation and assessment reports undertaken by HSO (2007; 2004; 2003a; 2003b; 2002; and 2001) were reviewed as part of this terrestrial ecological assessment. In this current report the survey area has been reduced in size from the previous reports and to exclude the previously approved residential subdivision that is currently being developed.

2.1.2 Vegetation survey & mapping datasets

RPS HSO Ecologists undertook a site inspection and vegetation survey on the 30 September 2008. The aim of this inspection was to map the vegetation communities within and directly adjacent to the subject site using a GPS and assess the trees present in greater detail. The trees within the subject site were surveyed for habitat values and to assess their age and health. Previously, RPS HSO Ecologists have undertaken site inspections to verify previous vegetation mapping and to assess the condition and habitat values of the subject site.

The vegetation assessment included a review of the Lower Hunter Central Coast Regional Environmental Management Strategy (LHCCREMS) regional vegetation mapping (House, 2003). The Coastal Saltmarsh, Mangroves and the Swamp Oak Floodplain Forest EEC are mapped as being onsite by the LHCCREMS.

2.1.3 Threatened species surveys and habitat investigations

Targeted surveys for threatened flora and fauna species considered likely to occur within the study area and adjoining lands were undertaken as part of previous investigations (HSO, 2001). Further threatened species habitat assessment has been undertaken as part of this ecological assessment report using information presented in HSO (2001; 2003b; 2004) and collected during the site inspections.

2.1.4 Bat Survey

Further bat survey was undertaken using an ultrasonic microchiropteran Anabat II detector over two nights on the 8 and 9 of October 2008.

2.1.5 Previous Survey Effort

Table 2-1 below summarises the field survey methods and survey effort carried out within and/or adjacent to the subject site. Previous flora and fauna survey reports undertaken by HSO (2001 and 2003b) have been attached as Appendix B, C and D to support this Terrestrial Ecological Assessment. The table below is also a comparison between the methods of Lake Macquarie City Council and DECC (2004) and the surveys which have been performed within the subject site during the current and previous surveys.

Table 2-1: Combined Survey Effort of Flora & Fauna Investigations within the Study Area

	Harper Somers O'Sullivan (*2001*) Flora and Fauna Survey and Assessment	Harper Somers O'Sullivan (*2003b*) Supplementary Owl Survey	RPS Harper Somers O'Sullivan (2007)	RPS Harper Somers O'Sullivan (2008) - Current	Combined Total	Minimum Lake Macquarie City Council Guidelines	Minimum DECC (2004) Requirements
Season	Winter (August)	Spring (November)	Spring (October)	Spring (October)	Winter and Spring	-	-
Location	Study area	North-western section of 2(a) zoned land (outside subject site , but within study area)	Subject site only	Study Area	Study area	-	-
Flora Survey Work	Random meander, 4 x quadrats and 4 x transects. Targeted threatened flora searches	-	Verify vegetation mapping, identify individual trees within proposal footprint.	Map vegetation in detail, 5 20m X 20m quadrats and random meanders. GPS trees in subject area and assess presence/absence of hollows and age of trees.	4 x Transects, 9 x Quadrats. Delineation of vegetation community boundaries noting vegetation and significant species.	3x walking transects + 1 quadrat per community + 1 replicate quadrat per community >5ha.	Transects - 1 x 100m transect per stratification unit <2 ha; Quadrats - 1 x quadrat per stratification unit <2 ha; Random Meander - One 30 minute random meander per quadrat.
Diurnal Bird Survey	General observation and call identification	General observation	General observation	General observation	Census, general and targeted surveys.	Sample plot counts involving 20minute searches within 1 hectare area. General observation.	Area search, wetland census, water source census.
Effort	Undertaken during each site visit	Undertaken whilst carrying out habitat searches	Undertaken opportunistically during site visit	Undertaken opportunistically during site visit	Estimated 9 hours targeted and incidental observations	1ha sample for 20 mins per habitat.	1ha sample for 20 mins per habitat.
Nocturnal Bird Survey	Spotlighting, stagwatching, call playback and call identification	Stagwatching, spotlighting, call playback and call identification	-	-	Stagwatching, spotlighting, call playback and call identification	Stagwatching, spotlighting, call playback and call identification	Call playback, day habitat search, stagwatching, spotlighting.
Effort	2 hours	3hrs	-	-	5 hours over four separate visits, various locations	5 hours over four separate visits, various locations	Call playback - 5 visits per site for Powerful Owl, Barking Owl and Grass Owl; 6 visits per site for Sooty Owl; 8 visits per site for Masked Owl. Stagwatching - 30 minutes prior and 60 minutes following sunset.
Herpetofauna Survey	General observation and hand searches in habitat	General observation	General observation	-	Diurnal-hand searches in suitable habitat for frogs and reptiles. Nocturnal spotlighting.	REPTILES: Diurnal systematic and opportunistic hand searches. Nocturnal searches for 10-20mins. AMPHIBIANS: September to February. Diurnal and nocturnal habitat searches. Playback of recorded calls.	REPTILES: Diurnal hand searches, spotlighting and pitfall trapping. November to March. AMPHIBIANS: Diurnal and nocturnal habitat searches. Playback of recorded calls.

	Harper Somers O'Sullivan (*2001*) Flora and Fauna Survey and Assessment	Harper Somers O'Sullivan (*2003b*) Supplementary Owl Survey	RPS Harper Somers O'Sullivan (2007)	RPS Harper Somers O'Sullivan (2008) - Current	Combined Total	Minimum Lake Macquarie City Council Guidelines	Minimum DECC (2004) Requirements
Effort	Unknown	Undertaken whilst carrying out habitat searches	Undertaken opportunistically during site visit	-	Estimated 5 hours	REPTILES: Diurnal - 30 minute searches on 2 separate days. Nocturnal - 30 minute search on 2 separate nights. AMPHIBIANS: Diurnal habitat search - 1 hour per stratification unit. Spotlighting - 30 mins on 2 separate nights; Playback - Once on each of 2 separate nights; Nocturnal habitat search - 2 hrs per 200 metre of water body edge.	REPTILES: Diurnal - 30 minute searches on 2 separate days. Nocturnal - 30 minute search on 2 separate nights. AMPHIBIANS: Diurnal habitat search - 1 hour per stratification unit. Spotlighting - 30 mins on 2 separate nights; Playback - Once on each of 2 separate nights; Nocturnal habitat search - 2 hrs per 200 metre of water body edge.
Bat Survey	Bat call recording (ANABAT) and spotlighting	-	-	Bat call recording (ANABAT)	Bat call recording and spotlighting	Harp trapping; Ecolocation Call surveys; Mist-netting and trip lines (only if considered suitable); diurnal roost searches and spotlighting.	Harp trapping, ultrasonic call recording, spot lighting and habitat searches. Trip lines and mist netting for targeted surveys.
Effort	1.5 hours bat call recording; 2 hours spotlighting,	-	-	2 Anabats set for 2 overnight bat call recordings, giving a total of four detector nights	1.5 hours bat call recording; 2 hours spotlighting, Four overnight bat call recordings	Harp trapping - 4 trap nights over 2 consecutive nights (October - March) per stratification unit. Ultrasonic call recording - 2 sound recording devices for the entire night (minimum 4 hours) for two nights (October - March) per stratification unit. Spotlighting - 2 x 1 hour spotlighting on 2 separate nights (October - March) per stratification unit.	Harp trapping - 4 trap nights over 2 consecutive nights (October - March) per stratification unit. Ultrasonic call recording - 2 sound recording devices for the entire night (minimum 4 hours) for two nights (October - March) per stratification unit. Spotlighting - 2 x 1 hour spotlighting on 2 separate nights (October - March) per stratification unit.
Terrestrial Mammal Survey	Terrestrial Elliott 'A' trapping	-	-	-	Elliott 'A' trapping	Elliott 'A' for small terrestrial, and Elliot B for medium to large terrestrial mammals, Hairtubes.	Elliott 'A', Elliott 'B' and / or cage traps and hair tubes.
Effort	15 x Elliott 'A' traps for 4 nights (total of 60 trap nights)	-	-	-	60 trap nights over 4 nights	Elliott 'A' and Elliott 'B' traps - 100 trap nights over 3-4 consecutive nights per stratification unit. Cage traps - 24 trap nights over 304 consecutive nights per stratification unit. Hair tubes - 10 large and 10 small placed in pairs for four days and four nights per stratification unit.	Elliott 'A' and Elliott 'B' traps - 100 trap nights over 3-4 consecutive nights per stratification unit. Cage traps - 24 trap nights over 304 consecutive nights per stratification unit. Hair tubes - 10 large and 10 small placed in pairs for four days and four nights per stratification unit.
Arboreal Mammal Survey	Arboreal trapping, Stagwatching and	-	-	-	Elliott 'B' trapping, spotlighting and stagwatching.	Arboreal Elliott B traps, arboreal hairtubes, spotlight surveys, stagwatching and faecal pellet counts.	Arboreal Elliott 'B' traps, arboreal hairtubes and spotlighting.

	Harper Somers O'Sullivan (*2001*) Flora and Fauna Survey and Assessment	Harper Somers O'Sullivan (*2003b*) Supplementary Owl Survey	RPS Harper Somers O'Sullivan (2007)	RPS Harper Somers O'Sullivan (2008) - Current	Combined Total	Minimum Lake Macquarie City Council Guidelines	Minimum DECC (2004) Requirements
	Spotlighting						
Effort	10 x Elliott 'B' traps mounted on trees for 4 nights (total of 40 trap nights); 2hrs spotlighting and stagwatching	-	-	-	40 trap nights over 4 nights; 2hrs spotlighting and stagwatching	Arboreal Elliot 'B' trapping - 24 trap nights over 3-4 consecutive nights per stratification unit. Arboreal hair tubes - 3 tubes in each of 10 habitat trees for at least 4 days and 4 nights. Spotlighting: 2 x 1 hour and 1km, walking at approximately 1km per hour on 2 separate nights.	Arboreal Elliot 'B' trapping - 24 trap nights over 3-4 consecutive nights per stratification unit. Aboreal hair tubes - 3 tubes in each of 10 habitat trees for at least 4 days and 4 nights. Spotlighting: 2 x 1 hour and 1km, walking at approximately 1km per hour on 2 separate nights.
Koala Survey	Spotlighting, habitat searches and general observation	-	-	-	Searches for scratch marks & scats, spotlighting and SEPP 44 assessment	SEPP 44 Assessment; SAT	Call playback, spotlighting and habitat searches.
Effort	2hrs spotlighting	-	-	-	Estimated 4 hrs	Habitat assessment including searches for scratch marks and scats and spotlighting. Call playback - 2 sites per stratification unit on 2 separate nights. Spotlighting: 2 x 1 hour and 1km, walking at approximately 1km per hour on 2 separate nights.	Call playback - 2 sites per stratification unit on 2 separate nights. Spotlighting: 2 x 1 hour and 1km, walking at approximately 1km per hour on 2 separate nights.
Secondary indications and incidental observations	General observation and habitat searches	Searches under each hollow-bearing tree for indication of owl presence; observation of hollow-bearing trees for usage (scratches, wear marks etc)	General observation and habitat searches	Habitat search of trees in subject site	Searches for scratches, scats, diggings, whitewash, nests, burrows, bones, feathers	Searches of suitable habitat	Searches of suitable habitat
Effort	Undertaken during each site visit	1.25hrs	Undertaken opportunistically during site visit	Undertaken opportunistically during site visit	Estimated 5hrs	As Necessary	As necessary

2.2 Vegetation Survey and Mapping

Harper Somers O'Sullivan (HSO, 2001) undertook a vegetation survey and vegetation community mapping across the entire study area, which included the subject site. The flora survey methodology consisted of a combination of quadrats, transects, random meanders and targeted searches for threatened flora species considered likely to occur within the subject site. Vegetation community mapping was undertaken using information collected during the flora survey using a Magellan GPS and aerial photograph interpretation.

The current survey included a site inspection which was undertaken by two RPS HSO Ecologists on 30 September 2008. The vegetation delineation and mapping methodology included the following:-

- Aerial Photograph Interpretation (API) to map the community(s) extent into definable map units;

- Confirmation of the community type(s) present (dominant species) via the undertaking of detailed flora surveys and identification, this has been done by walking around the each of the delineated vegetation communities with a Trimble Recon GPS drawing a line to gain accurate mapping of the saltmarsh, mangroves and Swamp Oak Floodplain Forest present within the adjoining unnamed bay to the west of the subject site. The remainder of the subject site was mapped using a combination of groundtruthing and API;

- The saltmarsh within unnamed bay to the west of the subject site was broken down into variants on the dominant species present to give a more detailed description of the saltmarsh species present within the study area;

- Review of the Lower Hunter and Central Coast Regional Environmental Management Strategy (LHCCREMS) Vegetation Mapping (NPWS 2000: House 2003) for the subject site and study area and surrounding areas;

- Flora surveys were carried out across Study Area with the general flora survey included 5 - 20m X 20m quadrats throughout the native vegetation within the study area (Figure 2-1), as well as Random Meanders in line with methodology termed as the "Random Meander Technique" by Cropper (1993); and

- Assessment of the potential for the derived vegetation communities to constitute EEC's as listed within the *TSC Act (1995*) and the *EPBC Act (1999)* was also undertaken. The floristic composition, geomorphological characters and geographic distribution were considered when determining whether an EEC was present.

2.2.1 Plant Identification

During this survey when a plant could not be identified accurately within the field, a voucher sample was collected, together with notes on habitat, form and height, labelled and identified according to nomenclature in Harden (1992 – 2002). Opportunistic sightings of taxa were also collected if they were not found in any of the sampled sites. At a minimum, all dominant species were identified in all stratums to ensure that an informed delineation resulted. All flora species recorded are documented in Appendix E.

2.2.2 Floristic Structure Information

Vegetation structure was determined based on Specht *et al,* (1995) by estimation of the height and projected foliage cover (PFC) within each stratum present. Individual taxon data for each quadrat/transect was recorded using the NPWS species data forms. Species abundances were recorded utilising a modified Braun-Blanquet (1982) cover abundance six ranking scale as follows:

Cover Code	Projected Canopy Cover
1	<5% and uncommon
2	<5% and common
3	6-20%
4	21-50%
5	51-75%
6	76-100%

2.2.3 Significant Flora Survey

A list of potentially occurring significant flora species from the locality (10km radius) was compiled, which included, threatened species (Endangered or Vulnerable) and EEC's listed under the *TSC Act (1995)*, those species listed on the *EPBC Act (1999),* ROTAP listed flora species (Briggs and Leigh 1996), as well as any other species deemed to be of local importance.

2.3 Tree Survey

The trees within the subject site were identified and mapped using the Trimble GPS and details of their age, height, health, DBH, spread and checked for hollows or fissures were recorded. Trees deaths or fallen trees were mapped within the new tree plan. A Safe and Useful Life Expectancy (SULE) assessment was undertaken for each tree to assess the health of each tree within the subject site.

2.4 Fauna Survey

Fauna surveys were conducted by HSO (2001) within the study area, utilising targeted methods to sample a range of fauna species. The main field surveys were undertaken 14-24 August 2001, with other site inspections carried out 14 June 2001 and 1 November 2001.

Methods employed by HSO (2001) included (Refer to the report for a full outline of the methods):

- fauna habitat assessment;
- significant tree survey;
- terrestrial mammal trapping;
- arboreal mammal trapping;
- bat call detection (Anabat II detector);
- avifauna survey (diurnal and nocturnal surveys);
- herpetofauna surveys;

- spotlighting; and
- secondary indications and incidental observations.

Targeted owl surveys were undertaken adjacent within the study area, but outside of the subject site, by HSO (2003b) on 12 November 2003. Methodology included:

- diurnal habitat searches under hollow-bearing trees for signs of whitewash, regurgitation pellets, prey remains, feathers, nesting material etc as evidence of usage by owl species;
- stagwatching of hollows;
- spotlighting;
- call playback of the Masked Owl (*Tyto novaehollandiae*), Powerful Owl (*Ninox strenua*) and Barking Owl (*N. connivens*);
- distressed prey imitation; and
- opportunistic fauna observations.

A further site inspection undertaken by an RPS HSO ecologist on 23 October 2007 assessed the fauna habitat present within the subject site and included:

- hollow-bearing tree survey;
- notes on the presence of important foraging resources (such as winter flowering myrtaceous tree species, *Allocasuarina* species, etc);
- habitat searches for evidence of fauna use such as scats, owl pellets, scratches on trees and glider incisions; and
- opportunistic fauna observations.

2.4.1 Additional Bat Surveys

Bat echolocation calls were recorded using an Anabat II Bat Detector. Emphasis was placed on those areas deemed likely to provide potential hunting sites for bats, including flyways, ecotones, forested areas and water bodies. Anabat call detection was undertaken during 8 and 9 October 2008 and 2 Anabat II Bat Detectors were left overnight for two nights giving four detector nights. The recorded calls were given to a recognised expert in bat species call identification for analysis.

TITLE:
Figure 2-1 Flora and Fauna Survey Locations

CLIENT:
Johnson Property Group

PLANNING SURVEYING ECOLOGY

HARPER SOMERS O'SULLIVAN

SCALE: 1: 3000 at A4 Size
DRAWN: Maya Beretta
APPROVED:
DATUM: MGA Zone 56 (GDA 94)
DATE: 27/10/2008
LAYOUT REF:
CONTOUR INTERVAL: N/A
JOB REF: 20970

241 DENISON STREET BROADMEADOW PO BOX 428 HAMILTON NSW 2303
T: 02 4961 6500 F: 02 4961 6794 E: survey@hso.com.au W:www.hso.com.au ABN 11 093 343 858

2.5 Survey Dates, Type and Prevailing Conditions

Table 2-2 depicts the dates, survey type and prevailing weather during the ecological investigations conducted by RPS HSO Ecologists during the 2008 survey period.

Table 2-2: Survey Dates, Type & Prevailing Weather

DATE	SURVEY TYPE	WEATHER					
		Temp	Rain (24 hrs to 9:00am)	Sun		Moon	
				Rise	Set	Rise	Set
30/09/2008	Vegetation Mapping and initial Tree Survey	9.3-21.8^{0}C	0mm	06:32	18:55	6:35	19:53
08/10/2008	Anabat Survey	4.9-20.5^{0}C	0mm	06:22	19:01	12:19	02:14
09/10/2008	Anabat Survey	5.7-21.9^{0}C	0mm	06:20	19:02	13:19	02:52
16/10/2008	Final Tree Survey	6.7-21.4^{0}C	0mm	06:12	19:07	20:55	06:33

Source: Australian Government – Geoscience Australia [http://www.ga.gov.au/geodesy/]
Daily weather observations – Newcastle Weather Station [http://www.bom.gov.au]

2.6 Limitations

A number of limitations / deficiencies were experienced during the course of these investigations and / or are inherent in the results data. These should be noted and considered in regards to the Trinity Point Marina assessment process, and include:

- the study area has been surveyed in Winter and Spring, so any plants that may only be detected in Autumn or Summer may not have been observed;
- the results of threatened species surveys are somewhat biased to those threatened species which are easily detected such as diurnal / sedentary birds, perennial plants and some mammals. Habitat suitability assessment coupled with the precautionary principle (has been used for threatened species where less survey effort was undertaken; and
- ecosystems and species distributions are dynamic in nature and are likely to change in time; therefore, the data presented should only be viewed as a 'snapshot in time'.

Data Availability & Accuracy
The collated threatened flora and fauna species records provided by the NPWS for the region are known to vary in accuracy and reliability. Traditionally this is due to the reliability of information provided to the NPWS for collation and/or the need to protect specific threatened species locations. For the purposes of this assessment this information has been considered to have an accuracy of ± 1km.

Threatened flora and fauna records within the region were predominantly sourced from the DECC Atlas of Wildlife Database and a DEWHA Protected Matters Search. Other sources such as Birdata and HBOC were also utilised. Limitations are known to exist with regards to these data sources and their accuracy.

Note: Data recorded by RPS HSO during the survey period, has been undertaken with a Trimble Recon GPS unit, which is capable of metre accuracy following post processing.

Where possible, these abovementioned limitations have been taken into consideration with regards to results interpretations, threatened species assessments and conclusions.

3 RESULTS

3.1 Flora

A total of 144 flora species were identified during the survey period within the subject site and study area within the quadrats and random meander surveys. A complete list of the flora species identified is provided in Appendix E of this report.

3.1.1 Vegetation Communities

Each vegetation community within the study area is described and classified under the Lower Hunter and Central Coast Regional Biodiversity Strategy (LHCCREMS, 2000). Eight vegetation communities were recorded (Figure 3-1) within the study area during a recent site inspection (October 2008):

- *Avicennia marina* Open Forest
- ***Casuarina glauca* Open Forest – EEC (Swamp Oak Floodplain Forest)**
- ***Eucalyptus tereticornis*/*Angophora floribunda* Open Forest – EEC (River-flat Eucalypt Forest on Coastal Floodplains)**
- ***Juncus kraussii* Saltmarsh – EEC (Coastal Saltmarsh)**
- ***Sarcocornia quinqueflora* Saltmarsh - EEC (Coastal Saltmarsh)**
- ***Sporobolus virginicus*/ *Sarcocornia quinqueflora* Saltmarsh – EEC (Coastal Saltmarsh)**
- Planted non-indigenous trees and shrubs
- Open Pasture.

The only vegetation communities that occur within the subject site are the Planted non-indigenous trees and shrubs as the Open Pasture.

1 Avicennia marina Open Forest

This vegetation community occurs along the edge of the estuary to the north of the study area and covers 0.2779 hectares. It is commensurate with MU 47 – Mangrove Estuarine Complex as described by LHCCREMS (NPWS 2000). Within this vegetation community, the canopy was observed to be regenerating on the fringes and invading other vegetation communities. Rubbish was frequently observed within this community.

Upper Stratum – to 10 m tall with a variable Projected Foliage Cover (PFC) of 0% to 20%. The dominant species was *Avicennia marina* (Mangroves) and included both mature trees and regeneration.

Lower Stratum – to 1m with a PFC of 80% to 90%, the dominant species being *Sporobolus virginicus* var*. minor* (Saltwater Couch) and *Sarcocornia quinqueflora* (Samphire). It must be noted that these species occurred within the ecotone areas between this community and the saltmarsh community.

2 Casuarina glauca Open Forest (EEC – Swamp Oak Floodplain Forest)

This vegetation community occurs along the study area foreshore. This vegetation community covers approximately 1.36 ha within the study area and approximately 0.39ha within the subject site. This vegetation community is commensurate with MU 40 Swamp Oak Rushland Forest as described by LHCCREMS (NPWS 2000). The majority of this vegetation community which occurs within the subject site consists of isolated *Casuarina glauca* trees with no indigenous understorey or groundcover present, these areas contain exotic pasture species within the understory. The north western edge of this vegetation community within the subject site has a canopy of young trees which are regrowth and the understory contains some floristic components of the saltmarsh vegetation community. These species include *Juncus kraussii* and *Sporobolus virginicus.* Whilst there are some components of saltmarsh vegetation within this area it has not been delineated as this vegetation community due to the canopy cover of *Casuarina glauca.*

Upper Stratum – to 10 m with a PFC of 40% to 60%, the dominant species being *Casuarina glauca* (Swamp Oak). The canopy species were observed to be regenerating along the foreshore but no regeneration was observed within the subject area or of the isolated trees.

Lower Stratum – to 1m with a PFC 50% to 80%, the dominant species being exotic pasture species including *Sonchus oleraceus* (Common Sowthistle), *Senecio madagascariensis* (Fireweed), *Ehrharta erecta* (Panic Veldtgrass) and *Pennisetum clandestinum* (Kikuyu). The native *Cynodon dactylon* (Common Couch) was dominant in the ground layer and occasionally *Juncus kraussii* (Sea Rush) and *Sporobolus virginicus* (Saltwater Couch).

3 Eucalyptus tereticornis/Angophora floribunda Open Forest – EEC (River-flat Eucalypt Forest on Coastal Floodplains)

This vegetation community occurs on the foreshore of Lake Macquarie on the eastern portion of the study area and covers approximately 0.32 ha. This vegetation community is commensurate with MU 38 Redgum Rough Barked Apple Swamp Forest as described by LHCCREMS (NPWS 2000). This vegetation community is highly disturbed having been subject to weed incursions. The understorey is composed of both exotic and native shrubs. Exotic grasses and herbs dominated the groundcover throughout the remainder of the study area. Three *Eucalyptus tereticornis* (Redgum) are present within the Open Pasture vegetation and have not been mapped as part of this vegetation community as they are isolated and are considered to be scattered trees.

Upper Stratum – 18m to 20m with a Projected Foliage Cover (PFC) of 30% to 50%, the dominant species being *Eucalyptus tereticornis* (Redgum) and *Angophora floribunda* (Rough Barked Apple). The health of these trees varied throughout the community's range and no regeneration of the canopy species was observed during the recent site inspection.

Mid Stratum – 1.5 to 2 m with a PFC 10%, the dominant species being juvenile *Casuarina glauca* (Swamp Oak). Other mid stratum species observed included *Acacia longifolia* and *Pittosporum undulatum*. One noxious weed, *Lantana camara* was also observed within the mid stratum of this vegetation community.

Lower Stratum – 0.3 to 1m with a PFC 80% to 90%, the dominant species being the exotic grasses *Ehrharta erecta* (Panic Veldtgrass), *Pennisetum clandestinum*

(Kikuyu) and *Avena fatua* (Oats) as well as the exotic herb, *Malva parviflora* (Small-flowered Mallow).

4 Juncus kraussii Saltmarsh – EEC (Coastal Saltmarsh)

This vegetation community occurs in two patches near the estuary to the north of the study area and covers approximately 0.1065 ha. This vegetation community is commensurate with MU 47a Saltmarsh as described by LHCCREMS (NPWS 2000).

Lower Stratum – 0.8 to 1.5m with a PFC to 90%, the dominant species being *Juncus kraussii* (Sea Rush), which formed dense mats interspersed with *Sporobolus virginicus* var. *minor* (Saltwater Couch) and *Sarcocornia quinqueflora* (Samphire).

5 Sarcocornia quinqueflora Saltmarsh - EEC (Coastal Saltmarsh)

This vegetation community occurs in a patch on the northern edge of the estuary to the north of the study area and covers approximately 0.04596 ha. This vegetation community is commensurate with MU 47a Saltmarsh as described by LHCCREMS (NPWS 2000).

Lower Stratum – to 0.1m with a PFC to 90%, the dominant species being *Sarcocornia quinqueflora* (Samphire) interspersed with *Sporobolus virginicus* var. *minor* (Saltwater Couch).

6 Sporobolus virginicus/ Sarcocornia quinqueflora Saltmarsh - EEC (Coastal Saltmarsh)

This vegetation community occurs around the estuary to the north of the study area and covers approximately 0.2429 ha. This vegetation community is commensurate with MU 47a Saltmarsh as described by LHCCREMS (NPWS 2000).

Lower Stratum – to 0.1m with a PFC to 90%, the dominant species being a mixture of *Sarcocornia quinqueflora* (Samphire) and *Sporobolus virginicus* var. *minor* (Saltwater Couch). Other species observed in this stratum included *Juncus kraussii* (Sea Rush), *Samolus repens* (Creeping Brookweed) and *Tetragonia tetragonoides* (NZ Spinach).

7 Planted Non-indigenous Trees and Shrubs

This vegetation community occurs throughout the southern half of the study area and covers approximately 0.5 ha. This vegetation community is not commensurate with the vegetation types described by LHCCREMS (NPWS 2000) and consists of planted trees in exotic pastures.

Upper Stratum – from 10m to 20 m with a 5 to 10% Projected Foliage Cover (PFC), included, amongst others, *Cinnamomum camphora* (Camphor Laurel, a noxious weed), *Ficus rubiginosa* (Fig Trees), *Liquidambar styraciflua* (Liquid Amber), *Quercus robur* (Oak) and *Pinus sp*. (Pine).

Lower Stratum – to 0.1m with a PFC to 90%, the dominant species being exotic grasses such as *Pennisetum clandestinum* (Kikuyu) and *Briza minor* (Shivery Grass) and exotic herbs such as *Cerastium glomeratum* (Mouse-eared Chickweed), *Trifolium repens* (White Clover), *Trifolium dubium* (Yellow Suckling Clover) and *Anagalis arvensis* (Scarlet Pimpernel).

8 Open Pasture

This vegetation community occurs throughout the remainder of the study area. It is a cleared community consisting of exotic grasses and herbs with isolated native and exotic trees. It was historically subject to clearing and grazing pressures and is subject to ongoing disturbance in the form of mowing.

Lower Stratum – to 0.1m with a PFC to 90%, the dominant species being exotic grasses such as *Pennisetum clandestinum* (Kikuyu) and *Briza minor* (Shivery Grass) and exotic herbs such as *Cerastium glomeratum* (Mouse-eared Chickweed), *Trifolium repens* (White Clover), *Trifolium dubium* (Yellow Suckling Clover) and *Anagalis arvensis* (Scarlet Pimpernel).

WARNING

Note that this Vegetation Community Map depicts clearly defined boundaries between vegetation communities that are the product of individual interpretation and are not distinguished by clearly defined boundaries 'on the ground'.

Therefore, this map should only be treated as an indication of approximate peripheries between delineated vegetation communities.

Caution should therefore be exercised when using this data for purposes requiring high levels of accuracy. Furthermore, no account for intergrading areas between delineated vegetation communities has been made.

LAKE MACQUARIE

This area is subject to a previously approved DA

This area is subject to a previously approved DA

0 50 100
metres

LEGEND

Subject Site

Study Area

VEGETATION COMMUNITIES

- Avicennia marina Open Forest
- Casuarina glauca Open Forest
- Eucalyptus tereticornis/Angophora floribunda Open Forest
- Juncus kraussii - Saltmarsh
- Planted - non indigenous
- Sarcocornia quinqueflora - Saltmarsh
- Sporobolus virginicus/Sarcocornia quinqueflora - Saltmarsh

Note: Remnant understorey vegetation exists only in the open space zoned acquisition lands

TITLE: Figure 3-1 Vegetation Map
Trinity Point

CLIENT: Johnson Propoerty Group

SCALE: 1: 2500 at A3 Size **DRAWN:** D. Landenberger **APPROVED:**

DATUM: MGA Zone 56 (GDA 94) **DATE:** 17/10/2008

LAYOUT REF:

CONTOUR INTERVAL: N/A

JOB REF: 20970

PLANNING SURVEYING ECOLOGY

HARPER SOMERS O'SULLIVAN

241 DENISON STREET BROADMEADOW PO BOX 428 HAMILTON NSW 2303
T: 02 4961 6500 F: 02 4961 6794 E: survey@hso.com.au W:www.hso.com.au ABN 11 093 343 858

3.1.2 Conservation Status of Vegetation Communities

Three Endangered Ecological Communities (EECs) listed under the *TSC Act 1995* occur within the study area and are listed below:

- Swamp Oak Floodplain Forest on Coastal Floodplains (mapped as *Casuarina glauca* Open Forest)
- River Flat Eucalypt Forest on Coastal Floodplains (mapped as *Eucalyptus tereticornis/Angophora floribunda* Open Forest) and
- Coastal Saltmarsh (mapped as *Juncus kraussii* Saltmarsh, *Sarconia quinqueflora* Saltmarsh and *Sporobolus virginicus*/*Sarconia quinqueflora*).

The *Avicennia marina* Open Forest, described in LHCCREMS (NPWS, 2000) as Mangrove Estuarine Complex, present within the study area is protected under the *Fisheries Management Act 1994*.

3.1.3 Regionally Significant Vegetation Communities within the Lake Macquarie LGA

The following vegetation communities which occur within the study area, are considered to be regionally significant within the Lake Macquarie LGA by Payne (1998):

- Forest Red Gum Forest (*Eucalyptus tereticornis/Angophora floribunda* Open Forest)
- *Casuarina glauca* Forests (*Casuarina glauca* Open Forest) and
- Lagoon Fringe Forests (*Avicennia marina* Open Forest)

The following vegetation communities which occur within the study area are considered to be of high conservation significance due to their natural rarity and historical clearing by the National Parks and Wildlife Service (2000);

- Redgum Rough Barked Apple Forest (*Eucalyptus tereticornis/Angophora floribunda* Open Forest) and
- Swamp Oak Rushland Forest, the vegetation community of *Casuarina glauca* Open Forest is equivalent to this Swamp Oak Rushland Forest and is listed as being commensurate with the EEC Swamp Oak Floodplain Forest..

3.1.4 Regionally Significant Flora Species within the Lake Macquarie LGA

No ROTAP listed species (Briggs and Leigh, 1996) were identified within the study area. One regionally significant flora species, Tallowwood (*Eucalyptus microcorys*), listed under LMCC (2001), was identified within the study area by HSO (2001) but no individuals were recorded during the 2008 site inspection. It is assumed that this individual occurred within the previous areas of adjoining residential subdivision.

3.1.5 Threatened Flora

No threatened flora species listed under *TSC Act 1995* and/or *EPBC Act 1999* were recorded within or adjacent to the study area during the recent site inspection in 2008 or within the study area during previous investigations (HSO, 2001; 2003b; 2007).

3.1.6 Threatened Flora Search Results

A total of 15 threatened flora species were recorded within 10 km of the study area (NPWS Atlas of NSW wildlife data). These included:

- *Acacia bynoeana*
- *Angophora inopina*
- *Caladenia tessellata*
- *Callistemon linearis*
- *Corybas dowlingii*
- *Cryptostylis hunteriana*
- *Diuris praecox*
- *Eucalyptus camfieldii*
- *Eucalyptus parramattensis* ssp. *decadens*
- *Genoplesium insignis*
- *Grevillea parvifolia* ssp*. parvifolia*
- *Melaleuca biconvex*
- *Pultenaea maritima*
- *Syzygium paniculatum* and
- *Tetratheca juncea*

An assessment of the likelihood of occurrence of these threatened flora species (contained in Section 4) concluded that no threatened flora species were considered likely to occur due to the absence of suitable habitat or absence from the subject site during targeted surveys. It should be noted that the subject site is quite disturbed, being primarily in a 'parkland' state, thus detection of any threatened flora was considered to be relatively easy. Additionally, no ROTAP species listed by Briggs and Leigh (1996) were recorded within the subject site.

3.2 Groundwater Dependent Ecosystems

GDE's is a broad definition covering all ecosystems which are dependent upon groundwater either permanently or occasionally to survive (DLWC, 2002). Two of the vegetation communities on the Trinity Point site have been identified as potential GDE's. Identification GDE's depends upon the location of the vegetation communities in relation to groundwater. GDE's are typically the communities which are located in drainage depression, swamps and creeklines, where groundwater comes up to the surface.

The NSW State Groundwater Dependent Ecosystem Policy sets out a Rapid Assessment Process for Groundwater Dependent Ecosystems. This assessment lists 8 steps for identifying and valuing GDEs. These are as follows:-

Step 1 Identify Geographic area

The study area is in Lake Macquarie LGA.

Step 2 List the GDE's

It is likely that both the *Casuarina glauca Open Forest* and the *Eucalyptus tereticornis/Angophora floribunda Open Forest* are situated on areas in which the groundwater is likely to be controlled by the water level within Lake Macquarie and not by recharge from rainfall within the vicinity of the study area. Therefore these two vegetation communities are not likely to be dependent upon groundwater for their moisture requirements. However, a precautionary approach has been taken here and these two vegetation communities have been assessed as being groundwater dependant, as they may in times of high rainfall be groundwater dependent when water tables are elevated.

GDE's have been classified into several different types according to DLWC (2006). These classes take into consideration aquifer, ecological and geomorphic types. The GDE's that have been identified on site include *Eucalyptus tereticornis/ Angophora floribunda Open Forest* and *Casuarina glauca Open Forest*.

Table 3-1 below outlines the GDE types, classes and sub-classes as per DLWC (2006) which occur within the site.

Table 3-1: GDE's Types and Classes for Trinity Point

Vegetation Community at Nords Wharf	GDE TYPE	Class	Description of Class	Habitat
Eucalyptus tereticornis/Angophora floribunda Open Forest	Riparian & Terrestrial Vegetation (T)	T1	Riparian Vegetation Community	Terrestrial
Casuarina glauca Open Forest	Marine Estuarine Habitats (M)	M4	Tidal Freshwater swamp forests	Epigean

The most likely groundwater system which the study area occurs in would be Shallow Alluvial Aquifer System.

Step 3 Assess the vulnerability of the GDEs

The two vegetation communities within the proposed marina development have been classed as GDE's. However, it must be noted that both these communities exist on areas where groundwater is controlled by water levels in Lake Macquarie and will therefore not be highly unlikely to be affected by the proposed marina.

Step 4 Assess value of the ecosystem and decide priorities for action

The proposal will not involve extraction of groundwater and the GDEs which are present within the subject site exist on areas where the groundwater is likely to be controlled by water levels in Lake Macquarie. Impacts from the proposal will be likely to occur from contamination and thus so long as appropriate base water flows are maintained then the impact will be minimal.

Priority actions include maintenance of base water flows and sediment and erosion control measures to ensure quality and quantity of groundwater is maintained.

Step 5 List management tools for protecting and managing GDEs

Steps such as maintaining base water flows and sediment and erosion control will mitigate any impact from the proposal on the quality and quantity of groundwater.

Step 6 Prioritise Management Actions

The water design for the project will be retained for the life of the project to ensure recharge of the groundwater. Wider management controls will be implemented by government authorities.

Step 7 Implement Management Actions

The water designs will be implement at the construction phase of the development and will continue to be monitored and managed throughout the life of the marina. Implementation of management actions for the groundwater systems as a whole is the responsibility of government authorities.

Step 8 Review

Review of the monitoring and research for the groundwater systems in the region will be the responsibility of government authorities.

3.3 Tree Survey Data

The trees within the subject site that are located within the vicinity of the boat lift facility which includes two steel runway beams were studied during the recent site inspection and are detailed below in Table 3-2. Trees which will be removed are numbered, 49, 171, 172, 173 and 197-217 inclusive and are shaded in grey in the table below. Figure 3-2 illustrates the position of these trees within the study area. Note: where more than one DBH is listed, it means the tree was multi-stemmed.

Table 3-2: Trees Surveyed within the Subject Site

Tree No.	Species	DBH (m)	Height (m)	Crown Spread (m)	Age (yrs)	Health	SULE
3	*Casuarina glauca*	0.5	12	6	16	Good	2a
6	*C. glauca*	0.5	10	7	8	Good	2a
10	*C. glauca*	0.4	5	6	8	Good	2a
11	*C. glauca*	0.2	3	4	5	Good	2a
22	*C. glauca*	0.35/ 0.25	6	7	5	Good	2a

Tree No.	Species	DBH (m)	Height (m)	Crown Spread (m)	Age (yrs)	Health	SULE
24	*C. glauca*	0.3	5	5	10	Fallen	4d
25	*C. glauca*	0.25	6	4	10	Fallen	4d
26	*C. glauca*	0.25	7	3	10	Fallen	4d
27	*C. glauca*	0.35	10	3	10	Good	2a
28	*C. glauca*	0.3	10	4	10	Good	2a
29	*C. glauca*	0.35	9	3.5	10	Good	2a
30	*C. glauca*	0.35	6	2.5	10	Good	2a
49	*C. glauca*	0.6	13	8	20	Good	2a
50	*C. glauca*	0.7	16	8	11	Good	2a
74	*C. glauca*	0.6	9	4	20	Good	2a
75	*Angophora floribunda*	0.3	6	4	20	Good Mature	1a
95	*A. floribunda*	0.25	9	5	10	Good Mature	1a
96	*C. glauca*	0.45	8	4	10	Good	2b
97	*C. glauca*	0.3	8	5	10	Good	2a
98	*Eucalyptus tereticornis*	0.6	8	12	18	Good Mature	2b
151	*Ficus rubiginosa**	1.2	20	12	20	Good	2a
154	*Pinus sp.**	0.9	18	12	20	Good	2b
155	*Ficus rubiginosa**	1.4	20	20	15	Good	1a
156	*Archontophoenix alexandrae*	0.6	12	5	8	Senescing	4a
157	*Archontophoenix alexandrae*	0.4	16	4	10	Mature	2a
158	*Ficus*	0.8	19	14	15	Good	2a

Tree No.	Species	DBH (m)	Height (m)	Crown Spread (m)	Age (yrs)	Health	SULE
	*rubiginosa**						
159	*Aracaria heterophylla*	1.1	25	12	30	Good Mature	2a
160	*Ficus rubiginosa**	0.2	3	3	10	Good	1a
161	*Ficus rubiginosa**	0.2	4	3	15	Good	1a
171	*E. tereticornis*	0.9	25	20	25	Good	1a
172	*E. tereticornis*	0.9	25	20	25	Good	1a
173	*E. tereticornis*	0.9	25	20	25	Good	1a
186	*C. glauca*	1.5	20	6	Adult	Good	2a
187	*C. glauca*	0.35	8	3	5	Good	3a
188	*C. glauca*	0.35	8	3	5	Good	3a
189	*C. glauca*	0.25	5	2	5	Good	3a
190	*C. glauca*	0.25	6	2	5		3a
191	*C. glauca*	0.45	8	0	10	Dead	4a
192	*C. glauca*	0.72/ 0.81	20	6	Adult	Good	2a
193	*C. glauca*	0.55	20	3	Adult	Good – lower limbs bare	2a
194	*C. glauca*	0.1/ 0.81	20	6	2.3	Good – lower limbs bare	2a
195	*C. glauca*	0.74/ 0.64/ 0.22	20	6	Adult	Good	2a
196	*C. glauca*	1.15	12	6	10-15	Good – missing some branch coverage	2a

Tree No.	Species	DBH (m)	Height (m)	Crown Spread (m)	Age (yrs)	Health	SULE
197	*C. glauca*	1.06	12-15	5	10-15	Good – leaning towards lake, some branch coverage thinning	2a
198	*C. glauca*	1.99/ 1.06	25	12	Old	Good	2a
199	*C. glauca*	0.3	6	2-5	5	Good	2a
200	*C. glauca*	0.31/ 0.31	8	3	5	Good – some dead lower limbs	2a
201	*C. glauca*	0.19/ 0.17/ 0.13	12	4	5	Good	2a
202	*C. glauca*	0.59/ 0.38	20	5	10	Good	2a
203	*C. glauca*	0.58/ 0.42	15	4	10	Good	2a
204	*C. glauca*	0.8	3.4	5		Good – water edge	2a
205	*C. glauca*	0.43/ 0.34	8	4	5	Good – water edge	2a
206	*C. glauca*	0.32	12	5	5	Good	2a
207	*C. glauca*	0.35/ 0.43	15	6	4-10	Good – some bare lower branches	2a
208	*C. glauca*	0.65/ 0.40	20	6	15-20+	Good	2a
209	*C. glauca*	0.71/ 0.78/ 0.45/ 0.47	24	12	15-20+	Good – few bare branches	2a
210	*C. glauca*	0.86/ 0.81/	18	10	20+	Good	2a

Tree No.	Species	DBH (m)	Height (m)	Crown Spread (m)	Age (yrs)	Health	SULE
		0.40					
211	*C. glauca*	1.01	20	10	20+	Good	2a
212	*C. glauca*	0.68	20	6	5	Good	2a
213	*C. glauca*	0.42	18	3	5	Good	2a
214	*C. glauca*	0.30/ 0.30/ 0.30	20	6	5	Good	2a
215	*C. glauca*	0.46/ 0.32	10-15	4	5	Good	2a
216	*C. glauca*	0.62	15	3	5	Good	2a
217	*C. glauca*	0.82/ 0.87	20	6	5-10	Good	2a

3.4 Vegetation Removal

A boat lift facility which includes two steel runway beams is proposed for Easement A for the marina in the northern portion of the subject site. RPS HSO has surveyed the trees in this area and removal of SOFF vegetation will be required. It is estimated that 0.04 ha (400m^2) of SOFF will be required for removal, with 1.31 ha of this vegetation community being retained within the study area. This is assumed to be a worse case scenario as trees will be retained where practical.

Trees 49, 171-173 which exist within the Open Pasture vegetation community will also be required for removal as part of the marina proposal. However during the course of the future studies the ability to keep one or more of these trees is to be undertaken with the relevant project application. The two trees numbered 3 and 6 which occur within Easements B and C will be retained as part of the proposal, as the infrastructure for the marina will be located so to avoid these trees. However some lopping of limbs may be required, albeit this will not impact on the EEC function.

The remainder of the subject site is exotic grassland resulting from historical clearing, few ornamental shrubs and old building and facility footprints that would require little vegetation clearance.

WARNING

No part of this plan should be used for critical design dimensions. Confirmation of critical positions should be obtained from Harper Somers O'Sullivan Pty Ltd.

LEGEND

- Subject Site
- Study Area
- *Angophora floribunda*
- *Aracaria heterophylla*
- *Archontophoenix alexandrae*
- *Casurina glauca*
- *Eucalyptus tereticornis*
- *Ficus rubiginosa*
- *Leptospermum polygalifolium*
- *Pinus sp.*

LAKE MACQU

0 50 100m

TITLE:
Figure 3-2 Tree Plan

CLIENT:
Johnson Property Group

SCALE: 1: 1200 at A2 Size **DRAWN:** A.Saddington **APPROVED:** D.Landenberger

DATUM: MGA Zone 56 (GDA 94) **DATE:** 21/10/2008

LAYOUT REF:J:\JOBS\20k\20970 - Trinity Point\Marina & Resort - 2007-2008\MapInfo\WORKSPACES\REPORT WORKSPACES\20970 Figure 5-1 Tree Plan A A2

CONTOUR INTERVAL: N/A

JOB REF: 20970

HARPER SOMERS O'SULLIVAN

PLANNING SURVEYING ECOLOGY

241 DENISON STREET BROADMEADOW PO BOX 428 HAMILTON NSW 2303
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3.5 Fauna

3.5.1 Habitat

Fauna habitat within the subject site was found to be limited to remnant trees and riparian vegetation. Winter flowering tree species recorded within the subject site include Forest Red Gum (*Eucalyptus tereticornis*), which may provide foraging resources for nectivorous bird and mammal species. Additionally, figs (*Ficus* sp.) located within the southern portion of the subject site are likely to provide some foraging habitat for frugivorous species such as the Grey-headed Flying Fox (*Pteropus poliocephalus*).

No hollow-bearing trees were recorded within the subject site or the study area. The HSO 2001 survey previously identified hollow-bearing trees, and these trees occurred outside the subject site and study area. During the recent site inspection, three mature Forest Red Gums (*E. tereticornis*) that would represent foraging habitat for a number of fauna species were recorded within the central portion of the proposal footprint.

The subject site consists largely of predominantly exotic grassland with scattered trees that offered little shelter for small mammals and reptiles. Some of the foreshore areas of Lake Macquarie contain shelter for small mammals and reptiles in the form of fallen timber, rocks or leaf litter. The absence of understorey species across most of the subject site would deter many fauna species.

The subject site is situated on the tip of the Morisset Park peninsula and as such terrestrial connectivity exists only to the west from the subject site. However, the subject site is largely cleared, so current connectivity is limited. Riparian vegetation with disturbed remnant understorey along the northern boundary of the subject site does provide some connectivity to vegetation to the west. Some tentative connectivity does remain between remnant canopy within the subject site and vegetation to the west; however, approved residential development at Morisset Park further limits the functionality of this tenuous link.

3.5.2 Terrestrial Mammals

The only terrestrial mammals recorded within the within the study area during the recent site inspection, consisted of introduced pest species including Rabbits (*Oryctolagus cuniculus*) and dogs (C*anis familiaris*).

3.5.3 Bats

Microchiropteran bat species recorded within the study area by RPS HSO (2008) included:

- Chocolate Wattled Bat (*Chalinolobus morio*);
- Large-footed Myotis (*Myotis adversus*);
- Long-eared Bat (*Nyctophilus* sp.);
- Eastern Forest Bat (*Vespadelus pumilis*); and
- Little Forest Bat (*Vespadelus vulturnus*).

Large-footed Myotis is listed as a Vulnerable species under Schedule 2 of the *TSC Act 1995*.

3.5.4 Threatened Fauna Species

One threatened fauna species was recorded within the study area during previous investigations, being Eastern Freetail Bat (*Mormopterus norfolkensis*). Another threatened fauna species, Large-footed Myotis (*Myotis adversus*) was observed during recent investigations. A further six threatened fauna species have been considered likely to occur within the subject site on at least an occasional basis, as assessed in Appendix F. Threatened fauna species considered to have a moderate to high chance of occurrence within the site include:

- Osprey (*Pandion haliaetus*);
- Swift Parrot (*Lathamus discolor*);
- Grey-headed Flying Fox (*Pteropus poliocephalus*);
- Eastern Bentwing Bat (*Miniopterus schreibersii*);
- Little Bentwing Bat (*Miniopterus australis*) and
- Greater Broad-nosed Bat (*Scoteanax ruepelli*).

4 ENVIRONMENTAL IMPACT ASSESSMENT

4.1 Identification of Threatened Species, Populations & Ecological Communities

Those threatened flora and fauna species (listed under the *TSC Act* and the *EPBC Act*) that have been gazetted / recorded from within the vicinity of the site have been considered within this assessment. EEC's and Endangered Populations known from the broader area have also been addressed. Each species / community / population is considered for its potential to occur within the study area and the likely level of impact as a result of the overall proposal. This assessment deals with each species / community / population separately and identifies the ecological parameters of significance associated with the overall proposal.

Those species / communities that have been identified as having either a moderate level of impact (or greater) as a result of the proposal or that have been recorded within the site during field investigations have been subject to further assessment within Section 4.2 and under 7 part test in Appendix F.

'Species' or **'EEC / Population'** – Lists each threatened species / EEC / population known from the vicinity of the site. The status of each threatened species under the *TSC Act* and *EPBC Act* is also provided.

'Habitat Description and Known Populations' or **'Habitat Description and Known Stands / Populations'** – Provides a brief account of the species / community / population and the preferred habitat attributes required for the existence / survival of each species / community / population.

'Chance of Occurrence within Subject Site'– Assesses the likelihood of each species / community / population to occur within the site in terms of the aforementioned habitat description and taking into account local habitat preferences, results of recent field investigations, data gained from various sources and previously gained knowledge via fieldwork undertaken within other ecological assessments in the locality.

'Likely Level of Impact within Subject Site – Assesses the likely level / significance of impacts to each species / community / population that would result from the proposed marina, taking into account both short and long-term impacts. This assessment is largely based on the chance of occurrence of each species / community with due recognition to other parameters such as home range, habitat use, connectivity etc. It also considers the scope of the proposal, including the likely 'ecological footprint', duration of construction works, proposed remediation works etc.

Table 4-1 Threatened Species Assessment

Species / Community	Habitat Description	Chance of Occurrence On Subject Site	Likely Level of Impact within Subject Site
Plants			
Acacia bynoeana Bynoe's Wattle (E, V*)	Small, prostrate shrub found in low heath and open woodland, generally on loamy clays and sand. Occurs from the Lower Hunter south to Southern Highlands.	**Low –** This species was not observed within the subject site during previous field surveys (HSO, 2001; 2003b, 2007) and any habitat is considered marginal due to past clearing and grazing practices.	**Low** – Due to the lack of individuals and preferred habitat observed on the subject site, this species is unlikely to be affected by the proposal.
Angophora inopina Charmhaven Apple (V, V*)	Small to medium tree found in shallow sandy soils in open woodland, swamp woodland and wet heath. The main occurrences of this species are in the Wyong and Lake Macquarie LGA's (from Charmhaven to Wyee and Morisset, and north to near Toronto), with disjunct populations also in Port Stephens LGA (south of Karuah).	**Low –** This species was not observed within the subject site during previous field surveys (HSO, 2001; 2003b, 2007) and any habitat is considered marginal due to past clearing and grazing practices.	**Low** – Due to the lack of individuals and preferred habitat observed on the subject site, this species is unlikely to be affected by the proposal.
Caladenia tessellata Tessellated Spider Orchid (E, V*)	A small terrestrial orchid, which regrows its single leaf on an annual basis. It is known to occur in grassy woodland and locally it has potential to occur within Coastal Plains Scribbly Gum Woodland. Flowers from September to October and is known to flower particularly after fire.	**Low –** The remnant vegetation within the site contains marginal potential habitat for *C. tessellata*. However, past clearing and grazing practices are likely to preclude the species from occurring. Additionally, little evidence of recent fire activity was present.	**Low –** Whilst some potentially suitable habitat may have been present within remnant vegetation, ongoing clearing, grazing and mowing of the subject site is likely to have precluded the species from occurring. Since this species is unlikely to occur it is also unlikely to be affected by the proposal.
Callistemon linearifolius (V)	Shrub that grows in dry sclerophyll forest on the coast and adjacent ranges. Re-sprouting / juvenile specimens difficult to distinguish from other *Callistemon* species such as *C. rigidus* or *C. linearis* without the aid of flowering parts.	**Low –** This species was not observed during the recent site inspection (2007) or previous field surveys (HSO, 2001; 2003b) and any habitat is considered marginal due to past clearing and grazing practices.	**Low** – Due to the lack of individuals and preferred habitat observed on the subject site, this species is unlikely to be affected by the proposal.
Corybas dowlingii Red Helmet Orchid (E)	A very small terrestrial orchid with a solitary red helmet flower that occur from June to August. This orchid has been recorded from 4 localities in NSW in the gullies of tall open forests on well-drained gravelly soils.	**Low –** This species was not observed within the subject site during previous field surveys (HSO, 2001; 2003b, 2007) and suitable habitat was not present.	**Low –** the site is not considered likely to contain potential habitat for this species which would have been precluded by the historical clearing and grazing. As this species is unlikely to occur on the site, it is unlikely to be affected by the proposal.
Cryptostylis hunteriana Leafless-tongue Orchid (V, V*)	Saprophytic orchid. Grows in swamp heath on sandy soils. Distribution limits N-Gibraltar Range S- south of Eden. Flowers December - February.	**Low –** The remnant vegetation within the site contains marginal potential habitat for *C. hunteriana*. However, past clearing and grazing practices are likely to preclude the species from occurring.	**Low –** Whilst some potentially suitable habitat may have been present within remnant vegetation, ongoing clearing, grazing and mowing of the subject site is likely to have precluded the species from occurring. Since this species is unlikely to occur it is also unlikely to be affected by the proposal.
Diuris praecox Newcastle Doubletail (V, V*)	Found predominantly in coastal Eucalypt forests on hilltops or slopes. This species has been recorded at a number of dry woodland locations to the south east of Lake Macquarie. Flowers July to August	**Low –** The remnant vegetation within the site contains marginal potential habitat for *D. praecox*. However, past clearing and grazing practices is likely to preclude the species. Additionally, it was not located within the site, despite surveys undertaken by HSO (2001) during the flowering period.	**Low –** Whilst some potentially suitable habitat may be present, this species was not recorded within the subject site. Due to the lack of individuals and preferred habitat observed on the subject site, this species is unlikely to be affected by the proposal.

Species / Community	Habitat Description	Chance of Occurrence On Subject Site	Likely Level of Impact within Subject Site
Eucalyptus camfieldii Camfield's Stringybark (V, V*)	Tree or mallee to 10m high, but often less. Rare and localised, in coastal shrub heath on sandy soils on sandstone, often restricted drainage.	**Low –** This species was not observed within the subject site during previous field surveys (HSO, 2001; 2003b, 2007) and any habitat is considered marginal due to past clearing and grazing practices.	**Low** – Due to the lack of individuals and preferred habitat observed on the subject site, this species is unlikely to be affected by the proposal.
Eucalyptus parramattensis ssp. *decadens (V, V*)*	Red Gum species that grows in dry sclerophyll woodland on sandy soils, often in low damp sites. Locally, this species occurs almost exclusively in association with Kurri Sand Swamp Woodland (KSSW) and ecotonal areas, but a small disjunct stand of stunted individuals have been recently recorded within coastal heath in the Lake Macquarie LGA (HSO pers. obs.).	**Low –** This species was not observed within the subject site during previous field surveys (HSO, 2001; 2003b, 2007) and the site is outside of the plant's geographical range.	**Low –** due to the lack of plants present on the site concerned.
Genoplesium insignis Variable Midge Orchid (E)	Occurs within a restricted distribution between Chain Valley Bay and Wyong in the Wyong LGA. Habitat is described as a *Themeda australis* ground cover layer with shrubs and *Eucalyptus haemastoma*, *Corymbia gummifera*, *Angophora costata* and *Allocasuarina littoralis* in the canopy layer. This species has been recorded within Lake Macquarie state Recreation Area to the south of Gwandalan.	**Low -** This species was not observed within the subject site during previous field surveys (HSO, 2001; 2003b, 2007). Furthermore, the highly disturbed nature of the site is likely to preclude this species from the site.	**Low –** Whilst some potentially suitable habitat may be present within remnant vegetation, ongoing clearing, grazing and mowing of the subject site is likely to have precluded the species from occurring. Since this species is unlikely to occur it is also unlikely to be affected by the proposal.
Grevillea parviflora ssp. *parviflora* (V, V*)	Occurs in light, clayey soils in woodlands. Most plants appear capable of suckering from a rootstock. Much confusion surrounds the taxonomy of this species and other similar *Grevillea* taxa (S. Bell *pers. comm.*), and a NPWS-funded study of the species is currently in progress.	**Low –** This species was not observed within the subject site during previous field surveys (HSO, 2001; 2003b, 2007) and any habitat is considered marginal due to past clearing and grazing practices.	**Low** – Due to the lack of individuals and preferred habitat observed on the subject site, this species is unlikely to be affected by the proposal.
Melaleuca biconvexa Biconvex Paperbark (V, V*)	A shrub to small tree, which grows in poorly drained areas from Jervis Bay to Port Macquarie.	**Low –** This species was not observed within the subject site during previous field surveys (HSO, 2001; 2003b, 2007) and any habitat is considered marginal due to past clearing and grazing practices.	**Low** – Due to the lack of individuals and preferred habitat observed on the subject site, this species is unlikely to be affected by the proposal.
Microtis angusii Angus's Onion Orchid (E, E*)	Record from the Terry Hill's district of Sydney. Occurs upon disturbed soil horizons that were originally ridgetop lateritic soils supporting a distinctive open to low community, Duffy's Forest Vegetation Community, which is listed as an EEC. Suspected occurrences in the southern Lake Macquarie hinterland are derived from a tentative record by Bell (1998) in the Lake Macquarie State Recreation area, which occurs to the south of Gwandalan. Flowers from May to October.	**Low –** The vegetation within the site contains marginal potential habitat for *M. angusii*. However, this species is extremely rare in the Hunter region and past clearing and grazing practices is likely to preclude the species. Additionally the species was not located within the site, despite surveys undertaken by HSO (2001) during the flowering period.	**Low –** Whilst some potentially suitable habitat may be present, this species was not recorded within the subject site. Due to the lack of individuals and preferred habitat observed on the subject site, this species is unlikely to be affected by the proposal.

Species / Community	Habitat Description	Chance of Occurrence On Subject Site	Likely Level of Impact within Subject Site
Pultenaea maritima Coastal Headland Pea (V)	The species occurs in grasslands, shrublands and heath on exposed coastal headlands from Newcastle to Byron Bay in NSW.	**Low –** This species was not observed within the subject site during previous field surveys (HSO, 2001; 2003b, 2007) and any habitat is considered marginal due to lack of exposed coastal headland habitat and past clearing and grazing practices.	**Low** – Due to the lack of individuals and preferred habitat observed on the subject site, this species is unlikely to be affected by the proposal.
Syzygium paniculatum Magenta Lilly Pilly (V, V*)	A shrub to small tree, found in sub-tropical and littoral rainforest on sandy soils or sheltered gullies mostly near water courses. Distribution between Bulahdelah and Jervis Bay. Hunter Region records confined to the Lake Macquarie hinterland (DEC 2005).	**Low –** No suitable habitat present (rainforest) and this species was not observed within the subject site during previous field surveys (HSO, 2001; 2003b, 2007).	**Low** – Due to the lack of individuals and preferred habitat observed on the subject site, this species is unlikely to be affected by the proposal.
Tetratheca juncea Black-eyed Susan (V, V*)	Occurs in a variety of forested and heathy habitats. Locally found in Open Forests and Woodlands with dense, undisturbed understorey, often in association with *Angophora costata* / *Corymbia gummifera* on slopes with south-easterly aspects.	**Low –** This species was not observed within the subject site during previous field surveys (HSO, 2001; 2003b, 2007) and any habitat considered marginal due to past clearing and grazing practices.	**Low** – Due to the lack of individuals and preferred habitat observed on the subject site, this species is unlikely to be affected by the proposal.
Herpetofauna			
Hoplocephalus bungaroides Broad-headed Snake (E, V*)	Largely confined to Triassic sandstones, including the Hawkesbury, Narellan and Shoalhaven formations, within the coast and ranges. Nocturnal, sheltering in rock crevices and under flat sandstone rocks on exposed cliff edges during autumn, winter and spring. Moves from the sandstone rocks to shelters in hollows in large trees within 200 m of escarpments in summer.	**Low** – Whilst there are some rock outcrops on the south-east bluff, it is not considered to provide suitable habitat for this species. Furthermore, there are no records of the species within 10 km of the site.	**Low** – Due to the lack of preferred habitat resources and local records, it is considered unlikely this species would occur within the subject site and as such it is unlikely that it would be affected by the proposal.